Streak camera as a new diagnostic tool for SIS18 ion beams*

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Streak cameras are typically used in electron accelerator facilities or plasma physics experiments to record processes with high time resolution. In 2014 a streak camera has been installed behind SIS18 at GSI. The streak camera will be used to study and optimize bunching and extraction of heavy ion beams from the synchrotron by measuring simultaneously in one spacial and in the time domain.

The extracted beam is observed with a BC400 plastic scintillator which is widely used in beam diagnostics. It has a rise time of 0.9 ns and decay time of 2.4 ns. It emits light with a maximal emission at 420 nm (violet/blue). Two scintillators are mounted in $45°$ with respect to the beam axis on a target ladder, which can be moved by a stepper motor. The scintillator is observed from below the beam axis. An optical system, consisting of four lenses and four mirrors, guides the emitted light to the streak camera. The optical system images 30 mm of the scintillator onto the 10 mm wide entrance slit of the streak camera, which observes the horizontal plane. Black moleton covering the setup enhances the contrast by excluding ambient light.

The installed streak camera is an "Universal Streak Camera", model C10910 by Hamamatsu. It allows streak times between 1 ns and 120 ms and has a motorized slit to be fully remote operable. Sensitive components, as the control PC, are placed in a measurement room, USB and firewire connections are extended via optical fibre. The whole system can be operated from the main control room of GSI via remote desktop access. In the fast extraction mode, the streak camera is triggered by the same signal, as the kicker modules of SIS18. It is generated in the electronics room by the Rf-system and has a jitter of 10 ns to 20 ns. By means of a delay generator one can account for trigger delays and time-of-flight of the beam. The long streak time of 120 ms is used to observe slow extracted beams. In this mode, the setup is triggered by timing events.

In autumn 2014 the streak camera system has been commissioned with different heavy ion beams from SIS18. Figure 1 shows the time-evolution of the horizontal profile of four bunches U^{28+} hitting the scintillator. The bunches hit at the same position, but obviously have different intensities. In Figure 2 the projection of streak data of an U^{29+}-beam onto the time axis is compared with the signal of the fast beam current transformer in the extraction line. In figure 3 the flattop voltage was chosen to low. The streak camera system also allows to resolve the spill structure and movements of the extracted beam during slow extraction .

First test with the streak camera in the SIS18 extraction line look very promising and show good capabilities to observe dynamics within the bunches.

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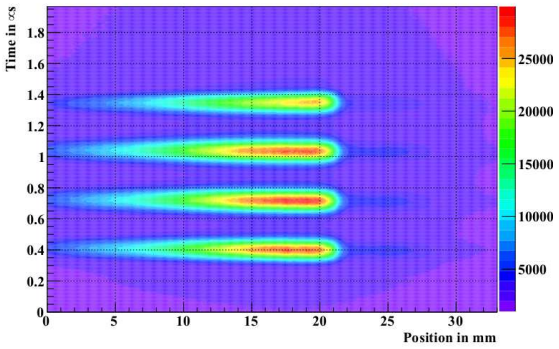

Figure 1: Streak picture of fast extracted U^{28+} beams at 200 MeV with four bunch operation (1H4). 30 pictures have been averaged.

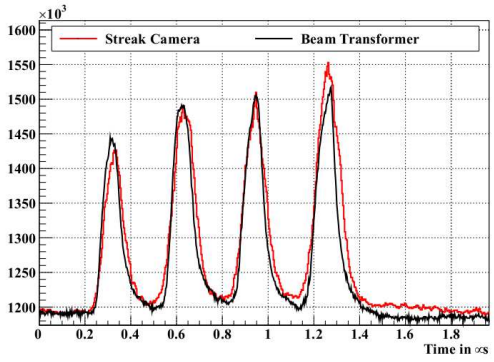

Figure 2: Comparison between the signal recorded with the beam transformer in the extraction beam line and the projection of a single streak picture onto the time axis for a U^{29+}-beam in arbitrary units.

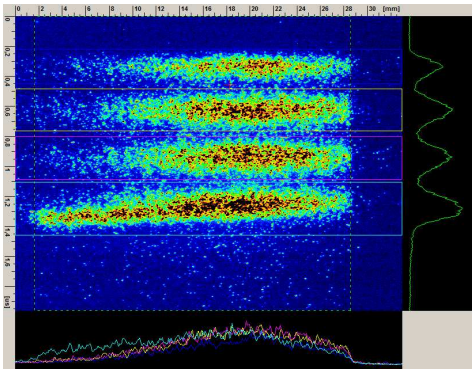

Figure 3: Screenshot from the online-display with U^{29+}-beam at 210 MeV: The flattop voltage (1 kV) is chosen slightly to low. The deformed bunch can not be recognized on the beam transformer.

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